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(72) Inventor: Al'tshuler Grigorij Borisovich,

(73) Proprietor: Al'tshuler Grigorij Borisovich

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(54) APPARATUS FOR LASER TREATMENT OF BIOLOGICAL TISSUES  
(ALTERNATIVE EMBODIMENTS)

(57) Abstract:

FIELD: medical engineering; surgery; orthopedics; stomatology. SUBSTANCE: proposed apparatus comprises at least one receiver of information about condition of biotissue to be automatically controlled. Receiver output is connected with input of control unit. Apparatus further comprises electronic switches arranged in current supply circuits of lasers and controlled by output signals issued by control unit. Finally, apparatus comprises two or three lasers emitting radiations at different wavelengths and having independent outputs. EFFECT: improved design. 7 cl, 5 dwgs

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(56) References cited:

WO, naTeHT, 90/12548, mu. A 61 N 5/00, 1990.

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(54) **YCTPOYICTBO J-JISI JIA3EPHOLI** OBPABOTKLI BVIOJIOP14<sup>1</sup> IECKOLI TKAHII  
[EPO BAPIPAHTbI]

(57) Abstract:

I'ICHOnb3oBaHHe: H3o6peTeHHe OTHOCHTCa K MeJLHL HHCKOLI TexHHKe H MO}KeT *6bITb*  
HeHonb3onaxo B xHpyrHH, opTone **nu u** cToMaTonomH. CynrocTb H3o6peTeHHcI:  
aBTOMaTH<sup>4</sup>ceCKHe KOHTpOlb COCTOHHHcI o6pa6amlBaeMoti **6HOTKaHH** H ynpanneime  
napaMeTpaMH H3nyleana na3epoa RocTuraloTCSI 6napoj;apsi CoBOKyrHOCTH BBejeHHbix B  
ycTpoficTna xOTb 61 OJHOO IIpICMHHKa HH4)OpMalHH o COCTOHHHH 6HOTKaHH, BbIXOg  
KQTOporo coecHHcH c BXOjOM 6noia ynpasneHux, H 9MOKTpOHbIX x.mocTeJL,  
ycTaBOBJIHHbIX B JienSIX rHTaHHcI na3epOB H ynpaBneMbix BbIXOJ(HbIMH CH:HaHaMH  
6noxa ynpaHeHHcI. Hanm THe B OAHOM yCTpOICTBe AByX HnH Tpex na3epou c pa3TDX'mblMH  
,HnHaMH BOTH H3ny<sup>4</sup>ceHH2 H He3aBHCHMbIX BbIXOgOB, a TaKKe B03MO)KHOCTb  
CMemXBaHHH H3nyceHHH 9THX na3epOB o6ecnex-nIBaeT B03MO)KHOCTb TpebyeMOpo,  
OpHeHTHpOBaHHO:O Ha MHHIMaJbHyIo HHBa3HBHOCTb pe}KHMa o6pa6oTKI. 5 yin.

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1411OXI9a 'ISNHauaEduX E310119 r10uox 3 H2HHM03 tfoXI9a E 'RHExL EH NHHLLonatffOa  
no,L3aw a Halaudio3 oIodo,Lox Ioxa 'NHBxs kIOxaahL10110Ng NNNHO.L303 o NLIYEI^d0(J)H1  
M11ny I4du Hato I4g H.LOX Hatfaaa 'EH.LONod.Latt NIOtoX14a N2x3ahw.Luo Ha.Launau o.Iodo,Lox  
tfoXI4a 'Y40NHhahOHEH 3 OHBOUGH 303133hLLUO YN ANaLJHO oiSm0(rtdhaLxo(I) EdafEu  
Ojodo.La 1130 903133hLLUO EH 0lmhH3UHOHE.La2C 'OHBOHLLasaal.L003 aodafEu o odo.La N o oadau  
XHoo EH I9Haxcououad alado,L0H 'Euemdaf EdafEU o.Iodo.LH marna 'P^Hauh' H11tf aeahEdEdOdu  
H Bda£8u oloadau Imliuoa lunwh' Huff aox9uaLwad,Lo oHHN,Lxauaa u al^1(4ua,LaXcad,Lo  
az4HHawlcduoa Nxaanz uo 'T414uaauedau XI4do,Lox Nao 3031aah0,L110 'I9dafEu al^H0u^Xul^N  
'aodafEu ISNHELLNU PtoIoUg a I9H3H111303 oaoDo,Iox I4tfoxi a 'ISNHauaEduk 310119  
aatna3adaffoa 'HHExx H0Xaah0L10110H9 113Is09Ed90 Vonda£Eu IsuY1Oa,LoNod,Latt h O,Lb 'NaLL  
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oaa 9.LaoHaN,Lx344£ 11eHhO,LE,L3o113H Ha.L3B1cH H ELaLoLodu Niox,LE.L.OOtfall HhaHHOHOo

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EH 'I1OXNhh3110BEH 3 B11310110a O.IOXaahH,LUO 310£2d3A H A Ia.L3H3 ouQHO£dH0xOH  
'edafEu oaoDo.La u3o HOHaahH,LUO EH a19HHawouou3L'd 'I4H9uauuedeu xlgdo,Loa  
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'Ea.LOljod.L3 notfox4a HO.Launaa £ tfoxI4a E 'HHBOH10a O.IOMoahHLLNO P101ROXI4a 3 Haxcuduo3  
11M03hMLUO O.Iodo,L0x^oxa OHHhDH0HHB H 'Eda£Eu vttoftoxI1a o HaskHduoa HxaahMLUo  
oaoDsox t1OXH 'aH310110a 0103133hLLUO xofads0 331110(EhOtU)1a '691CE x 1111HahC1EH  
HxaE iootf oal.Otfad3 H dafEU grum h0CU^H Ha0 ROxaahHLLUO 4uofa 319HH3)1C0L1ON3Ed  
oh^uaLEaotfaaou aa2HBaxdaffoa 'H1t1ExylugS1 E LB1 '00/9 O 19 V 'L0610/06  
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a OHBaO£4u0113N 4s149 .L3MCONI H 31Nxxa.L U0x3HN11NfaNI x 180.10u011,1,0 aaHasadgofyI

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\*HHHauaadud Exoug 14EZfoxl4a  
 x H1iikUIHahOiaAttOU 'HNEHEl ita HNI<sup>2</sup>HJ.HHLENIODj.xauc HaxC9EH3 HNIEToaoduottttgOa  
 IsHHaHhHiaO0 a.laaNI a dooaduNiox *alg arAlGOH E 'EHJ aHODj a~i HNIETfoXI9a Lu'u9Hhou' IEJHdda*  
*ISOLOH LcaU H XEAHHHahO3I H a 14HOHH11a190 x1<sup>2</sup>do.Lox 14tloxi a 3HiUOIAa,LaaJ,003*  
*'Edo3aadu\*loX o.loi ma tfoa H Nloaooaa NniT 1foa Igloa Trutt EdEAda9ad fli*  
 v Januso.Laoa 'nni ogadgo MHOgHHHamfodo HONiaJ.3HO OHa3H9EHa oa,Loada.adc oueua.LIHHUouorf

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 aHHauHEdIEEH O.Lh 'NIOcEdgo NHME.L.OIHHauBOHE.1a4C 'EaHHNlandu o.103IaahL.L3jMe attH 'a  
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\*ISHHanaEda E.LHaNlaue H aodioxaalfai.o4  
 HM IaHHU 'E LHaWauc o.10HHOH3dau3Htt fH o.132IIISO.La03 11 YHEXl.EIi ISHU.Lal/latfGoa NIO.L33NI  
 a Haxcdxuaa Hxa0hHLLUO o.IOdO.LOM tiOxa 'NH **0051-00Z** HL0EI90 H Eda.LEfHUEHEOd.Lxaui attHa  
 a HoH11OU14a 41119.LOHCO<sup>4</sup> HHE3L.LIOxaahH.IOHIO19 HHHISO.L303 o HHl ENIdo(J)HH 314HY3QHdj

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 variorum x14HHQd&.xaut HNEIfoxa a 14110HHIla0a o.10do.LOX 'HhHallauda  
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 o.Iodo.IAx tIOXa 'HnExJ. UO313ahL.IOHOU9 HHHHIO.Laoa o MHZENIdolHH NIOMHHNloadu NIHHIO  
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 11 E14JaMa HEZHO.L dHa2cxotr EHaHC011ouOED ISHHahld1e1l & fox ou oHg1L2.LEHOH11a1a0  
 EdacEu oaoadau H30 VOx3ah1J.UO EH E 'H1HaAl(gH EZIOX CH Oda Ettoa14a o14J0oHJ.KOYQEOa  
 3 0HO11aOHEJatt OHExdae aoi4L.Ca.LExCedso \*H ared,au YQOX0u9 3 EdacEu alOIJ)KEM H1HOHHtfaoa  
 xHildl a X19HHalfao4reLo '1~a001lfX XlquiHODj.xauc HY4EtOXa a 14HoHh11eo3 ouodoxox

143BeCTHO, 'ITO 9 4eKTHBHOCrTb na3epHOH o6pa6o'rKHN 6Nonorxtecxolz TKann C OTpHOBeMeHHHM o6ecne'ieHHeM H113KO2 NHBa3NBHOCTN (CreneHH HeKp03a) 3aHHCNT OT MINHbI HOTHBbI N MOHJHOCTN na3epHOH N3nyTeHHH, 3Heprnn N HpeMeHH na3epoxo B03TjeHCTBHH, a TjHH HCKOTOpbIX BHTJOB TKAHH zKHTTJKOCTHOpo OromeHHH 30HbI na3epHOH o6pa6o'rKH (cM. HanpMep Proceeding of Laser-Tissue Interaction v 24-27 January 1994, Los Angeles, California Vol 2134A).

NecnegofaHHH, npoBeJieHHMe anToMoM, noxa3anL, wro npN 9ToM Heo6xoJHMa OT(HoBpeMennaB OnTNM3a111st yKa3aHHbIX napaITpoB a c p Ka c opO Bill a 6NOTKAHH. H4HBIMN CnOaBMN, HeoXOT(HMbI: B03M0)KHOCrTb Bb160pa OHTNMajIbHBIX MIIIH BOMH N3ny'ieHHH na3epo rum Nx CMedu, perHCTpaunH npoecca na3epHOH TjecTpyKB;NH, BNTja N COCTOHHH 6NOTKAHN N ynpaBneHH TjnlHOH HOHH, MOIIBOCrTbio, 9HeprLe2 N BpeMeM na3epHOH TjeicTBN51, cHcrema OpoineHHH 3OHM na3epHOH o6pa6oTKN.

COBOKpOCTb BBaJieHHbIX B yCTPOMCTBO XOTbI 6b1 0,14HOpo npaMHNKa 14H4OpMaljIH O COCTOHHH o6pa6aTbIMaMo aonorHuexon TKAHN, BbIXOT TOTOPO COCTHHeH c BXOgOM 6noKa ynpaBneHHH, N 9eKCTPOHHbIX Kalloue2, ycTaHOBJeHHx 1x Bb1em nTaHH na3epOM N ynpaBneMbix BbIXogH IMN cHrHanaMH 6noKa ynpaBneHHH, npejicTaBHHOT co6oH CNCTeMy o6paTHOH CB513N, KOTOPa o6ecneHHBaeT an'poMaTH'ieCKHe KOHTpOIB N OHTNMaYIBHOC ynpaBneHne napaMeTpaMN Harly'ieHHH na3epOB B 3aBHCNMOCrT4 OT BHT;a N COCTOHHH o6pa6aTbIMaMo2 TKAHH N 'rem CaMbIM o6ecnewBaeT MNHManbHyo HHBa3NBHOCTb.

Heo6xoJaMoCTb aBTOMaTH'ieCKHX KOHTpOIBH ynpaBneHHH Bb13BaHa 'iaCTO B03HKA1011jeH HeB03M0)KHOCrblO B143yambHOPO OnpCTjeHHH Hpa'IOH COCTOHHH o6nyTaeM05I TKAHN N ee BHTja.

Hanatlae 7,7y; HC313HCNM:IX BbIXOT(OM B OT HOMyCTPOICTBe 6napOTjapH B03M07KHOCrTb Bb160Tja OTpaKaTenbHOPO 3epxana 143 xOT(a H3JbTeHHH Hlepnoo na3epa, a TaKJKe B03M0)KHOCrTb CMeuJLbaHHH 143JyUCHN2 TjByX na3epOB HOBBHaeT 9(4eKTHBHOCrTb pa6OTbl ITN o6pa6oTxe 614OTKAHN N o6ecne'mBaeT CHH)KCHHe HeKp03a - - - - -

HanatlHe H OT(HOM yCTPONCTBC T(n51 o6pa6OTKH 6NonOrrmeCKo2 TKAHN TpeX na3epOH C pa3HH'HHBM T(1HMaHN HOJH N3ny'ieHHH N He3aBHCNMbIM BbIXOT(aMN H c B03M0KHOCrTbO CMenHBaHHH N3ny'ieHHH o6ecne'iaBaep HaN6OmblyIO M06HJIBHOCTb npaMeneHHH yCTPOMCTBa N MaKCMManbHO pacMupae' ero H03MOXHOCTN. HanpIMep, npN OTJHOBeMeHHOM B032(eICTBHHH POnbMHeHHM H HCOJHMOBH na3epaMN Ha o6HnbHO KpOBOJiaCbinjaloume opaHbl CHNMaeTCH OnaCHOCTb KpOBOTe'ieHHH npN HeCaHKH,NOHNpO6aHHOii nep4opalj1N KpyHHbIX KpOBeHOCHbIX coCTyOB, MIA CMeYHBanNSI N3ny'ieHHH TpeTberO na3epa c T(ByMH T(pyTLMN Hm Ka?KT(b1M 143 MTH BBCgCHbl OTpaKaTenbHOe H ceneKTNBHOe 3epKana, ycTaOBneHHble COOTBeTCTBHHO K OCSMI TpeTbCrO N DTOPON 11a3epOB, a B03M07KHOCrTb Bb160Tja OTpaKaTbHHX 3epxan N3 OTTja 1131ly'ICHN51 14 HanJie T(OHTHH4TCHbHHX ~OKyCNpyIOH)TDCNCTeM H OHTH'ICCKHX BOPOKOB o6ecne'iaBaeT He3aBHCNMOCrTb TpeX OHTH'ieCKHX BbIXOT(OB yCTPOICTB.

AOJIOJHHTenbHO BBe)CHHaH B yCTPOMCTBa CHCTeMa OpoineHHH, ynpaBHeMaH 3eKCTPOHHbIMN KJianaHAMN, IOI(KnIO'ieHHbIMN K BbIXOTaM 6nmKa ynpaBneHHH, o6ecne'iaBaeT onTMManbHOe cogeTaHHe pe?KHMOH o6nyTeHHH N OpoHeHCH TKAHN.

COBOKyIHOCTb N3002KieHHX B 4 opMyne N306peTHH31 npJ3HaKOB HBaHeTCH HOBOJI, a canto TeXHN'ieCKOe pemene yHOBJICTBOHT KpITePc110 "14306peTaTenCKNLI ypOBeH".

Ha Ipar.1 N306pa?KCHa CXeMa ycTpoicTBa Tjns na3epyo i o6pa6oTKH 6NoTKAH; Ha 4Nr. 2 CXeMa yCTPOMCTBa npH Hana'n4N TpeX na3epOB; Ha (MP. 3 CXeMa BapHaHTOB BbHOJHCHHH H pacnon02KeHHH npHeMHbIKOB HHd opMaHNN O COCTOHHH o6pa6aTbIMaMo2 6NOTKAHN; Ha tMr.4 cHeTeMa opoieyelln 30HbI o6pa6oTKN; Ha (DNr.5 6nox-CXeMa 6noia ynpaBneHHH.

VCCTPOMCTBO aH na3epHOH o6pa6OTKH 6nonorH'iecaok TKAHN 4Nr.1) COCTONT 143 6noKa ynpaBneHHH 1, COe.(NHeHOpo c H14M 6noxa nTaHHH 2, NMnybCHbIX na3epOB 3, 4, coeJHHCHbIX c 6YOKOM nTaHHH 'ieje3 3eKCTPOHHbIX KnIO'HN 5, 6, KOTo6ne no KnIO'ieHH

**K BbIXOgaM** 6ноха ynpaBneHHn 1. Ha onTLIuecKnx coax нacepOB 3, 4 пaчнono?xeHbl CoOTBeTCTBeHHO OTpaKaTenbHOe 3epKaJO 7 н CenexTMBHOc 3epKaJO 8, KoToпble onTHuecKII conpH KeHbl MelKgy co6oa c (поKycHpyionjeЛ eneTeMol 9 H BblXOgHblM ToпpIOM onTHueCKOpo BOIOKHa 10 c HaKOHe "HHKOM 11, пaчнono7KenbIX Ha OHTMUP.CKO\$ oca на3epa 4. CeneKTИBHOe 3epKaHo 8 OTpaKaTeЛbHO гнсл H33ly'ieHHn c гTИHHOH BонHbl на3epa 3, no nпо3пaтuo Knn H3nyueHnn c гHHO\$ Bonи на3epa 4. Пaчнono)KeHHoe Ha OHTHueCKOH OCH на3epa 3 OTpaKaTenbHOe 3epKaHo 7 нOгKpИOУeHO K BbIXOgy 6ноха ynpanneHnn 1 H B H0102KeHHM A ycTanaBnnnaeTCn nog yrhoM 45° x ocil, a B nonOxeHHDI B napanneim o efi. Ha 9TOLI lice oCH ncneg 3a 3epxanoM nocnejjоBarenbHo no xony M3nyueHHM пaчнonozeIn 1 4)oxydHpylonjan cneTeMa 12 n onTHuecxOe BOTIOKHO 13 c HaKOHeHHKOM 14. K BXOgy 6ноха ynpanneHH 1 nogxmo"eH 3neKTpnyeCKHI BbIXOA npMeHHKa HH(popMaуn : oCOCTOHHHM 6HononneKoIl TKaH 15, BXOg KOTOpO COIпpHHeH c MeC'TOM B03jellCTBИH Ha 6HOTKaHb 16. CHCTeMa nnpnax nzi 17 no)jUnIOUexa K TeM KC BbIXOJaM 6ноха ynpaoneHЛIcI 1, 4TO 11 6нох нHTaHHH 2, a ce Bo \$HOYI n Bo3,ByIBHb11 BbIXOgl 18 M 19 o6'egmeчbл B HaKOae "HMKc 11 (14).

Ha (Dnr. 2 nпeгeTanneH BapHaIT ycTpoЛICTBa c TpeM\$1 на3epain 3, 4, 20. Ha onTz1 eeKовi oCM на3epa 20 ycTaHOBeHO OTpaKaTenbHOe 3epKaHo 21, KOTOpoe Tax Me, Kax H OTpaKaTenbHOe 3epxano 7, nogKnoyexo K 6нOxy ynpaBneHn 1, H B nonO)KCHHH A yCTpaHaBHaebTOH nog yrhoM 135° K onTHueCKOH OCH, a B HonO)KeHHM B - napannenbno eЛI. Ha 9TOLI lice onTИUecxoil oca пaчнono)Keubl 4)oKycлpylonia\$ cHCpeMa 22 H BXOgHOЛI Toпeу onTHueCKOPO BOIOKHa 23 11 HaKOHeHHKOM 24. MewKny (поKycнpylonjeЛ cHCTeMo 9 H CeЛeKTHBHblM 3epxanoM 8 ycTaoBneHO BToпoe ceneKTMBHOe 3epKaHo 25, xOTOpoe onTMueCKM ConpH?KeHO c 3epKaIIOM 21, (poxyenpylonjeИ CHCTeMOЛI 9 n BXOgHblM ToпpIOM onTHueCKOpo BOnOKHa 10. CeneKTЛBHOe 3epKaHo 25 OTpaKaTeЛbHO гrин n3TyeHH3I c гнHHOЛI BонHbl на3epa 20, He nпо3паЛHO grin H3nyUCHИЛ c гTИHHaMH BOIИH на3epOB 3, 4. BноK нHTaHHH 2 coeгиHeH c на3epoM 20 uepe3 9неКТpOHHblH KpИOУ 26.

Pa3HOBIHOCTbMH npHeMHMKa ИИт)OpMaЛIЛM 15 o COCTOHИHHH 6HOTKaHH 16 MoryT 6HTb KaK CneKTpoaHan3aToп 27 (4nn'3), BXOg KOTOpOpo OHTИZUeCKH conpсI KeH c MeCTOM B03jeЛCTBИH Ha 6HOTKaHb 16 cCOCTOHИИ 143 гHcaePCMOnHOPO 9TeMeHTa 28, нHHeИKH 44OT'OreTeKTOTOB 29 11 9IICMeHTa CpaBeHHcI 30, TaK H (OTOTИCTKToWueCKMLI npHeMHMK HH4ппaKpaCHOo H3nyueHHM 31, onTHueCKИ4 Conp\$)KeHHblИ c MeCTOM B03jeЛCTBИH Ha 610TKaHb 11OCпeгCTBOM onTH'ueCKOPO BOTIOKHa 13 (10. 23), (поKycHpylonjeЛ CHCTeMb 12 (9, 22) 11 BOBOOTHOpo 3epKaHa 32, пaчнono KeHHoro Melcпы 4 oKycHpylonjeИ CHCTeMOИ 12 (9, 22) H 3epKaHoM 8 1)ИH nenocпeгCTBeHHO neпeг BbIXOgBblM 3epKaHoM на3epa 3 (20). Илeгe onTHueCKHM BXOgOM (4OT09неКТpIueCKOpo npHeMHMKa 31 ycTaHOBeH MH4пaxпaчнbl 4pHnbTp 33, nonoca npOHyCKaHHH KOTOpOPO neKHOУaeT nonagaHe Ha 4)OT03неКТpIueCKИ1 npHeMIIHK 31 143nyueHHcI на3epa. B KaueCTBe npHeMHMKa HH4opMaуMH 15 o COCTOHИHHH 6HOOnH'icCKON TKaHИ 16 moKCT 6b1Tb 11 aKyCTHueCKHИ npHeMHMK 34, пaчHoH2KeHHblИ 116111311 MecTa B03jeЛCTBMn Ha TKaлb TaK, 'ITO HanpaBneHne ero MaCKMMO)бHOИ UyBCTBHTeЛbHOCTH COCTaBHeT c onTMueCKOЛI 00,10 H3nyueHHcI Ha BbIXOge HaKOHeHHH 11 (14. 24) ypon a, ne nauuuu B nпeгeHax OT 11 go 86°.

**B CBИ3И c TeM, 1TO MHЧIO npHeMHMKOB HHH)OpMaUMH o COCTOHИHHH 6HOTKaHH MOKCT** KOne6aTbCH OT OгHOPO гOBИTH (no Ka?KгOMy BИJly, OKOHO Ka2KгOpo HaKOHeUHHKa), KOnиUcCTBO B03)OB 6ноха ynpaBneHnn *moKCT* 6b1Tb пaBHO гeBИTH.

CMCTeia opomeHnn 30x1 06pa6OTKH 17, M3o6пaxceHHaH Ha 4)ir.4, COCTOИT 143 пe3epnyaра grin B0gl c B0гHbHblM HaCOCOM 35, x KoToпOMy npMcoeгMHeHa B0гHnpOBOJИaH Tпы6Ka 18, n B03гyИИHOo xOMneccopa 36. RпHCoeгHyHeИИbe x B03гyИHOMy KoMyпeccopy 36 B03гyXonpOBOгHjMe Tпы6H 19 CHa62KeHbl 3HeKTpOMaHMTИBИHM xnananaMM 37. 38, 39, xOTopie nogI)лoueHbl c TeM lice BbIXOgaM 6ноха ynpanneHnn 1, yTO H 6н OK нMТаHMA 2,1epe3 nXHHH 3aгeпxcиn 40, 41, 42.

ycTpoиCTBO пa6oTaeT CJИpylonjHM o6pa3oM. 143)IyueHnn на3epOB 3, 4, 20. B cnyvae HaXOJKeCHM\$ OTpaKaTenbHbIX 3epxan 7 M 21 B ИOHO2KCHHH B, npoNgi (4OKYCHpylonjHe CHCTeMb 9, 12, 22, onTгeгeHue BonoiHa 10, 13, 23 M HaOHeHHKM 11, 14, 24 nocTynaIoT

Ha OUTH<sup>1</sup>ieCKMe BbIXO)TbI yCTpO ICTBa.

Eenn OTpa?KaTenbHble aepxana 7 H 21 HaxO 5xTCa H HOTOncHHH A, H3Tb<sup>1</sup>ieHHe на3epa 3, OTpa3HBIUBCb OT 3epxana 7, nonaJ aeT Ha ceneKTHBHoe 3epxano 8 H, oTpa3H ииeб OT Hero, Hanpannsleren ngonb onTH<sup>1</sup>ICCI O l oCH на3epa 4. AHanormnio. npH HanxtnyL на3epa 20, H3nyeHHe на3epa 20 OTpa3HBIUBCb OT 3epxana 21, a 3aTeM OT CeneKTHBHOrO 3epxana 25, TaK%e HanpaHneTes BJIOnb OHTI ecKOll ocn на3epa 4. B pe3yHbTaTe, B CBH3H co CBOJICTBOM CeneKTHBIbIX 3epKan 8 H 25, B 4JOкyc *ipyIondlo* CИCTeMy 9 H Ha OHTH<sup>1</sup>ieCKИ5 BbIXOJИ HaKOHec<sup>1</sup>на3Ka 11 MOpyT n OCTynaTb H3Hy<sup>1</sup>ieHHH BМХ TpeX на3epoB OJИHOBpeMeHHO.

Bbl6op HHAa npHeMnyxa HH4OpMaw n 15 o COCPONHHH 6HOTKaHH 16 3aBHCHT OT HHга TKaHH H pe2KBMa o6pa6OTKH, a TaIQKe OT HHJJa HaKOHetHHKa. 1Ipa pa6oTe c HeKOHTaKTHbIMH HaKOHec<sup>1</sup>ниHKaMM OCHOBBaH MacTb H3Jy4CHHH 3p03HOHHOpO 4 arena, H03HHxalolJepo H3-3a cBe<sup>1</sup>ieHHH ygameMbxx <sup>1</sup>acTm 6HoTxaim, ne7KHT B HJIИ(HM05 H 61THKHHX ynb Tpa4)HOneTOnO5 H HH(HpaKpaCH05 06наCTHx cneKTpa [200-1500] HМ) H HBTISiefCSI npH<sup>1</sup>инH05 HeO3MO?KHOCTH HH3yanbHOpO Ha6nlo)(eHas HHга H cOCTOHHHH 6HOTKaHH.

CнеKТpaнbИbИY COCTaB H3TbI<sup>1</sup>ieHHH 9p03HOHHOpO (arena 3aBHCHT OT HHга 6HOTKaHH, HO9TOMy HeoXo/ HM CнеKТpaнbИbИ5 <sup>1</sup>aHaTH3 3ToPO H3TbI<sup>1</sup>ieHHH, KOTOpOe nonajaeT Ha gHCHePCOHHbHbl 9neMeHT 28 CнеKТpoaHap3aToPa 27, paanaraECTH B cneKTp H nonajaeT Ha nHHeIKy 4OTOJTeKTPOB 29, coci HHeИИyJO c 3aCMeИHOM CpaИHeHHH 30. YpoBenb BbIXOgИOPO 3неKТpИ<sup>1</sup>ieCKOpO cИгHana 3неMeHTa cpaBHemн 30 COOTBeTCTByeT KOHKpeTHOИ7 KOM6ИHaИИИ JyHH BOYH CнеKТpa H3nyTeИH5I 9p03HOHHOpO 4aKena. BнеKТpИ<sup>1</sup>ieCKHИ CHpHan OT 3неMeHTa cpaИHeHHH 30 cneTpoaанл3aToPa 27 nocTyнаeT Ha 6HOX ynpaBHeHHH l, r a Hblpa6aTbIbaECTH CHpHan H3MeHeHHH pexcmMa H наpaMeTpoU H3nyeHHH на3epoB.

Pa6oTa c KOHTaKTHbIMH HaKOHedHHKaMH CBH3aHa c HarpenaHHeM на3epИbИM H3Hy<sup>1</sup>ieHeM Toplia pa6o<sup>1</sup>iero HHCTpyMeHTa (BOПOKПOвaH can4 LpobBlll HaxOHemmx) JIo TенepaTypbl, JIOCTaTO<sup>1</sup>HH05 JyH H3apyHeHHH 6HOTKaHH. HarpeB MecTa Bo3JleJICPBHH COnpOBOMaeTCH BO3HHKHOBeИHeM HHcpaKpaCИOpO H3Jy<sup>1</sup>ieИH5I, KOTOpOe nepejaeTCH HO BOПOKИy HaKOHec<sup>1</sup>HHKa 11 (14, 24) H OHTH<sup>1</sup>ieCKOMy HOIOKИy 10 (13, 23) B HanpaBHeHHH, O6paTHOM XOJy 1a3epИOpO H3Hy<sup>1</sup>ieИH5I, OTpacaeTect OT HOHOPOИHOpO 3epKana 32, npoxoJИT HH4paKpaCИbI2 ИHbTp 33 И nonajaeT Ha 4oTo3неKТp4eCKHИ пpeMHHK 31. 9неKТpИeCKH5 CHpHan c BbIXOJJa 4 OT03неKТpИ<sup>1</sup>ieCKOpO npИeMHHKa 31 nocTyнаeT B 6HOX ynpaxueмн l, r je B 3aBHCHMOCTH OT HapaMeTpoB 9TOPO CHpHana Hblpa6aTbIbaECTИ CHpHan OCTaИOHKH, npo on?KeHHH HHИ *H3MeHeHHH* peacZMa pa6oTbI на3epa.

3KHePHMeliTanHO yCTaHOBeHO, 4TO TenJIOBOe H3TbIeИHe, Bo3HHKaЮИее npH pa6oTe c KOHTaKTHbIMH HaKOHec<sup>1</sup>HHKaMH, Haxo wren B my6oxo2 ИH(ppaKpacHon o6наCTH. B 9TO2 o6наCTH TbyCTBHTCJИHOCTb 4)OT03неKТpB<sup>1</sup>ieCKHX npHeMHHKOB o<sup>1</sup>Иb Mana. CнеITpaнbнаx o6наCTb H3Hy4eHHH на3epoB Taxxce nexciT B HHCPaxpacноиr o6наCTH. HIO3TOMy nonOca nponyxaeИH5I HH4paKpacИopo IДHbTp 33 cогласoпa co CнеKТpaнbHO2 TbyCTBHTeHBOCTИO 4 OTOnpHeMHHKa 31, c oKHOм Hp03paTHOCTH onTHeCKOpO HOYIOKHa 13 H o6eцeтHxaeT HeKnoлoexue nonaJJaHHH Ha 4 oToпpexwиK 31 H3nyTeHHH на3epoB 3, 4, 20.

1IropyKTbI на3epHopo 3a3pyeИH5I 6HOTKaHH 3a3HeTaloTCH co CBCPX3ByKOB05 CKOpOCTИO, Л B CneJCTBHe peoxopo H3MeHeHHH aанneHHA H3-3a cонпоTHHeHHH cpejbl rexepxyeTCИ axycTHecKas Bonи-Ja. Ann 3aTИP<sup>1</sup>HHaЛ TKaHC5 awwwTyга aKyCTИMeCKOJИ BOИHbl paalzH<sup>1</sup>Иa. AMnuwTyJJa axycTmeCKo2 BOJИИы perCTpИpyeTCH aKyCTИHeCKИM пpeMnino 34, 3неKТpИ<sup>1</sup>ieCKHИJ CHpHan c xoToopo n OCTynaT Ha 6HOX ynpaBHeИH5I 1, r je cИHTe3ИpyeTCH cИpHan BpeMeHHOИ OCTaHOBKИH3Jy<sup>1</sup>ieИH5I MИH H3MeHeHHH pen xi a pa6OTb на3epa B 3aBHCHMOCTH OT THHa o6pa6aTbIbaionUeic TKaHH HnH B cnyтae npeИbнeИHHH 3HeprИH на3epHopo HMnyHca Hag nopOpOM paapyHieHHH 6HOTKaHH, tTo BnxSeT Ha CTeneHb на3epHopo HeKpo3a.

1 IpxameИie B cnyтiae HeoXOJИ4MOCTH pexcmMa H3Hy<sup>1</sup>ieИH5I на3epoB B COOTBeTCTBHH C

hHrHanaMa CneXTPoanau3aToPa 27, 40T09neKTpaUecKOPO Hna axyCTHuexorO  
 nPHCMHHKOB 31 H 34 nO OHCXOJ[4T c HOMOnbIO 6BICTPoge cTH3onux 9JIKCTPOHHbIX Rummel  
 5, 6, 26. CHrHna c 6noKa ynapbHeHHcI 1 nogae'rH. Ha ynapbHnromn; nBXOJ 9TeKTpaOHHO  
 Klnoua 5, (6 26) pa3MaKbaI, gne, nHTaHHCII xa7KJ(Oa H3 na3ePO. BpeKpanenHe HMnynba  
 H3ny'ICHHR 9 CKT14880, cGrH BpeMCI OTKPOKOTCH4SI mTaHHCII McHbme jHTHTPaIIOBCTH  
 HMnyTnna H3nyueHne CII. (AawTenbHOCTb HMnyTnna H3nyueHne MO7KCT 6nTb 150-500 i. c.).  
 1109TOTOMb B KaeCTBe 9neKTPOHHO O Kanoa j on KCH HCOIIOITbO3aBbICI 9neMCTHT c BbICOXOM  
 6BICTPOeTTeBHEM. Taxman ynapncneMbmnm xnoauea SEIMTo'r-1 nOTIynO6OJ; jnKOBHe  
 HRH 9neKTPOBaxxyM6le nepexnoaTeHh, BpeM5 cpa6amaHHCII KoTOpblx He npe6bIIIaeT  
 100 Mice.

OpomeHHe 6HOTKaHH HOMOIWJO eHTCMbi 17 npoHCXOJ ITT cneyx>ng4M o6pa3oM. 143  
pe3epHyapa jfnsi BOHbI c BOjHHbIM HaccocoM 35 Hog a 3aHonHCie'p BOj (onpo3o) single TP6KHN  
18. B cnyaye HobeXojMaMocTH opomeHHCT KaHH CHPIIHaBO H3 6noxa ypaneHHH 1  
IIOCTyHaIOI Ha YTKCTPOMaIHHTHMI KnaHaH 37 (38, 39), KoI'ObbI oTKpinae' T  
noCTyHeHHHe Bo3pyxa oHI HaBneHHHe H3 BO3jHHHOPO KOmpeccopa 36 B BO3jYXOHOBOH  
19. KOHII, I BOjOj H BO3pyXOnPOBOjisiIH,IX TP6KO 18 H 19 paCuOn03KeHbI B HaKOHeHH'HXaX I  
[14, 24] TaK, "ro noCTyHeHHHe BOHbI Ha HppHpaFioHHeBb BbXOjJH yCTPOiICTBa  
HOHCXOJ ITT npH no3jae BO3pa3a no npIHU,HTpHbBepa3a'ropa.

CH<sub>2</sub>HanbI H3 6nOKa ynpaHHemui 1 noeTynaIoT Ha 9PCKTpOMaPHHTHbIC KnaaHbI 37 (38, 39) yceп3 nHHHH 3aHCp2KKH 40 (41, 42) OJHO6pCMCHHO c CH<sub>2</sub>HanaMH 3aHycKa LIMHnбCOB reuepag3a na3epoB 3 (4, 20).

OpolneHHe 6HOTKaHH BOJ OM) OWKHO npOHCOXO 1Tb B npOMCJIKyKaX MeJIKJy HMJbncCaHM HJTyelHHJI na3epoB (c genbio H36exaTb HeKKenaTeJbHOe pacceJIHHe H3nyeHHp H IOBbIcHTb 90eKTHBHOCTb OpeMeHHH), nOTOMy JIHHTenbHOCTb BpeMeHH 3aHCp2KKH RHHHJI 3ajipexCKH 40 (42, 4) paBHa BpeMeHO JBTenHOCTH HMnyHCTOB H3JyTeHHp na3epoB c yueCOM BpebHeHH nocbuebHHJI B03J Xa K KOH3a TPb6OK 19.

IPr1Mep KOHKpCTHOL1 pcan13a1IHh 3aB8a8eMbix yCTpO1ICTB COCTOHT B Cnejiij1011jCM. BTIOK  
 MaBpaBReHHH 1 (4Hr.5) OCTOHT 113 yC1yH1Hh1H BXO11jHh CHPHanoB a HHTepaToPM (CM.  
 I1paB8eHHIKOB B.B. CnpOTHH A.L. "13C6HaPaTeHbH8 RC yC1pHTTeH M. 3HeprH8P, 1980,  
 cTp. 69) BOCBMHKaHaH8HOPO jCeHTpH3a11ij1H8HO aHaTIOPO-11B pOBOPO npeo6pa30BaTeH  
 (ALM) c nocneji0BaTeHbH8M HHTep1e2eCOM max 192 cepH8 CM. KaTanop MAXIM 1993),  
 npo2eccopa PC-104 c KBapTeB8IM reHePaToPM (CM. KaTanop Konco11tayMa Advantage real  
 time devicе AMPRO, 1993 cTp. 103-184) H BOCBMHKaH8H8HO TP1H1aj1raTa11pa1181 10  
 11udipa11oanOBopo npeo6pa30aTeH81 (L1A11) c nocneji0BaTeHbH8M HHTep1e417cOM max 540  
 cepH8 CM. KaTanop MAXIM 1993). Bb1XO11jHh CHPHani L1A11 a118181818181 Bb1XO11jH8M 8nox  
 ypaHH8H181 1, no TPeM H3 KOTOpb1X, KpOMe CHPHanoB 3anyCA HM8H8H8BOB reHeapa3a,  
 1OC1Tyna1OT CHPHani, onpe1e18K10M181 BCa111111H81 3HeprH8H8Ka10HTTeHbH8IX KOH11;CHCAToPOB  
 8nox aB-TaH8R 2 (CM. BORKOB 14 B. "1CTO-11HHKH nHTaH8R na3epOB , TeXH8HKA, KHeB, 1976,  
 cTp.118).

B Ka<sup>ε</sup>cTbE na3epoB Hcnoab3yoTc na3cpeb: Nd:YAG (JjmHMa Bonnbl 1,06 maim Haa 1,32 MKM, Ho:YAG (j mma BOHbH 2,09 MKM) H Ec:YAG (GvmHa BOHbH 2,94 MKM). B KauecTBe JIKHepechoHopo 9ncHeMa 28 CTCKcHh 51 np3H3Ma, B xauecTBe 4ToTgeKTOpO 29 KpeMHebHebble noOynpOBOfiHHKOHebble (pOTOfiHHH 41-256, a B KauecTBe JIKToTOfiH9ncKpTHeCaXOPO np144mHHKa HHfpaKpOHocHO O H3TbTeHbH 31 repMaHHebBn7 4pOTOfi) 7-9. 9ncHeMOT cpa6HebJHcH 30 MHKpocxeMa K554CA3 min LM-11. AKycTHuecKH7n np144mHHK 34 MHKpOHH K4138.

Tatum o6pa3MoM, npeanaeaeAJble yCTpoLicTBa 3a CueT cB03yHHOCTH 3aHHHceM6Mx napa3HaKOM, o6eeneHHaBHaB onepaTHBHOCy ynapaeneHHHe c B03MOMKHOCThIO BapbHpoBaHHpB nH3HOKOM jiana3oHe napaMeTpaMH naepHOH 13THTHeHHp, H03BONpHOT opOB0JHTT xapupHycCKHe npecepyHT Ha 6H0TOKaHx B KaueCTBe nH6o cKaHbHce, na6o KoaepHtyTa, nH60 jicTpyKTopa B 3aBHCOMOCTH OT Tpe6eM6Mx THPOB, peKHM0B H cogeTaHn6a pa6OTH B 3aBHCOMOCTH, OpeHTHpoBaHH6Mx Ha MHHHMaM6MlyIO TpaBMaTHTHOCTh nPH jiaH440M BHIje B03TjeCTBHP Ha jiaHHyIO 6H0TKa6M.

'Eda£EU uHhahAU£t  
XHHMlIdU EH aHHE11E11011 L131HOteHOfux3H 'ISHHExaAUOdu 11030lrou 3 dLl9un4 £adah  
aol L3EH aalnoadn3Axo(l R ad3£EU kouandaf L4I9H1fOx19a 1O1xrat4 EdafEu H3o bloxoahLLUo  
EH o.IOxxaxrououoad 'Euaxdaf o.IOH.LOdoau YQOa.L311'adaon 9HE31.1, EH #Ha.L3Ha1Lea 140,13314  
3 ISHH33ICISd103 Oa03133hYLL110 uuf H3HLIOU9a O.Iodo.Lox liouu 'ISHH3haA1£H ouon3Ed)ed(oliH  
ExMHN1314dl1 o.IOX3ahxdJ.xauco,LO(1 3YlHa a H3HU01119a HHE£L HO3133hLJO110H9  
11HHH0.L303 o HHYE£N4Oq)HH MHH43hdU O,Lh 't13L IS3311HOIEHaLUO 'g H run OU oa.LOLIOdoLoA 't

'axI3HaEd3 E.LHo1aus  
H aOdol xa,tallo.LO4I HMHphHU 'LHaL43116 o.IOHHOH3d3U3hd £H O.la71IKO.L303 H '9liax L  
EH ISYia.L3pul£Oa NO,1331 3 ISHH33K£duo3 o.103133h1/L110 ISW1 H3Hfou19a oJOdo.LOM 110Xa  
'NH (JOM ooz H.Loa1190 a EdO.LE£HUamaod,Lxau3 a)1Ha a H3HU01119a HHEILL HOx33haa0UGH9  
HHHUOL303 o HHHEL4d0(1HH xxxmaadu o,th 'Ysal u331uorEhHU.1,0 'g H 't111011 oELLagodLaA -c

'HVHE.LHH P1014009 3 Eda£EU 0a01131c£x xHHB114013a3 Xxn311 a Xi#HhausaOHE1a1f 'l£3h01131  
x19HHOd.Lx31le Nioltotxiaa 3 ImHaHHd3a3 oaodo.Lou i IoxI9a 'uaH3uaaduA Ex0119 P10110Xa  
3 H3HR11303 1loxI9a a 'max., EH Hfa.L393r£Oa 140.L31A13 ISHH33ICISd103 uuf l13H1101119a  
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xI9d0.Lox 1911oxi a 'Y103HHH3H0aEH 3 OH3IOU0a 30x33hL1UO H EY31.L,axa 1SEIUOrAdH3A304  
I9Haxrouou3Ed xauahAu£H 14lox ou on9ua.Laaothraou aoda£Elr oaa9.Lad.L H oaoadau  
14300 £H H013KE31 EH '0,01, af'loxd 'Macau o.Iodo.La 113o EH xI91aH331CO10u3Ed 'E1310110a  
0.103133hL1UO P10110xa H HOY73.Lox3 HatnoxAda3Aa04 'ada£EU o.Ia9L3cLL aoo 90x33hL1UO  
EH Nu9HHaia0HE.L31C 'nouexdaf 149H9u3J axred.Lo a aoHH331Cndu03 H313ahH.L110 'oL£exdaf  
aoda£EU o,lodota m oaoadau Huoa HHU1 uuf'1 aollhed£odu H ada£EU o.Ia9.Lad.L 19HUOa  
19:HHU1f ISU1 aol'1r LExrEdLo OHaH.L313133 3odQLa ol1311nOHE.L3X P10UE31d£ N119HhH.L313c33  
E£ adacau oaodo.La 1130 HOx33haLUO EH E 'HHH3hAuEH affox EH XH all oaI9a oL9.L3oHwoN£Oa  
3 19H3uaoxv,LOA Eumxdaf,aI9I9ua.LExCEd,LO Wahadu 'OUExdaf aonqua.LExred.Lo onaLaoniaoA  
H30 O.1a an E 'aoda£EU =dAd 1 xAa1l P11(3o 14Hx33hL1UO aI19uauuadu oaodo.Lom  
4ao tuxOahxLUo 'da£Eu L aoaalHcu 4H IJa.Lad.L Hallaaa wax a o.1h 't1aL IS3311HOIEHaLUO  
'aa.Lonod.LoA nolloxiga NuMOahBLUO x3.LaxLlaa cuodo.Lox Vox14a 'YZOMH1UaH0aEH  
3 oxxcouou aOx3ahILLUO'H Atiwaiaxo ox noiAdx3Aa04 'ada£EU oaodo La Rao Ylox33hLL110  
EH olgHHausaOHE,L011C OHHaa.L3.L0a.L003 'aoda£EU oaodo.La m oaoadau XH30 xHx3ahH.L1Uo  
EH I9Haxtouou3Ed ai'do.Lox 'EL£exdaf Edocau oaodo.La 19HUOa 19HHu1 u1f a19Hed£odu  
H Eda£Eu ouoadan I9Huoa 19HHu1 guff aOH9ua.Laxcad.Lo OHaH.L.131ou33 H 3oH9uaLExrEd.Lo  
a19unoucdno3 Hx3ahILLUO 'I9H9uauuedau xI9d0xox H3o OHx33niLUO 19da£Eu  
ax9H39uAU'1H 'aoda£Eu xMHE.LHH Poxoug a paioHHfao3 oaodo.Lox 1911oxI9a 'onHauaeduit  
moO) aaluxatdfo3 'HHE£L LloxahH.10110149 Hxcoxagdo LloxdafEu guff oalazod,L3A 'Z

'aa t, od.L3A 14011oxi9a PHx33hH.L110  
1'RH 1Adli ua amux 'oaodo.Lox 1foxI9a 'PoxHHb0H031EH 3 oxxcouoa 00313ahii LUO HEY13.L343  
#elnoLAdx3Axo() anoxrououad ISHHahAut£H Aliox ou on'ua.LEaol(auoou Edacau oaoadau  
H3o HOx3ahZ.Luo EH a #HHahAut£H E11ox £H an Etioal9a oi'LaoHfCON£oa 3 OHanaOHE13  
ol.Cexdaf aOH9ua.LExcad to 'o,ol, o xodx 'unna1.HU 40310119 3 Edocau oJolixet uHHaHfHaaiaoa  
XISU311 a X19HH3moHEloA 'U3h01H31 x19HHOd.Lxau HNa1foxa 3 19Haxx1fao3 oaodol ox  
W15oxlaa 'umuouaeduA Exoug 14oltotxa 3 11oHHH303 1loxI9H E '9HEX1, EH ISHS IaSJa1ies  
O.LOQPI 3 101113xClid03 #old HaxaOLHYa oJOdOLO1 fOxHa 'HHEML 10x33hHao11OH9 HHHUOL303  
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'Ea1.LJod.L3A Yqokfoni£a IYH33hLL110 a3.L3ISLau oaodo.LOM iioxnga 'NoHHb0HOIEH  
3 OH5OUOa 00X33hH.LUO H 14WL3H3 otAuo41dH31C31041 Eda£Eu oad0101 1130 1303133hH.LUO  
EH a19nnauaona,lo OHH3H.L3.L3a.L003 'aoda£eu o.Iodo.La m oaoadau xuoo XRxoahH.LUO  
am I9Haxcouon3Ed otados ox 'EU£xadc ada£EU oaodo.La lanuoa 19HHU1f gulf aollhed£odu  
H 'Macau oaoadau IaHU0a 1WHHUIf gulf aonqua.LExad.Lo 0Hai.Lx0113o H aolJ9LC.1 LExCED LO  
al lumom #duo3 H3133hL1UO 'rInquauedEU x1'oou.Lou Rao 'Macau  
o19 oauFuYa 'aoda£Eu #13HE.LHU 1'10x0119 3 19113HHH1303 oaodo.Lon I4iox19a 'ISRxaauaEdUL  
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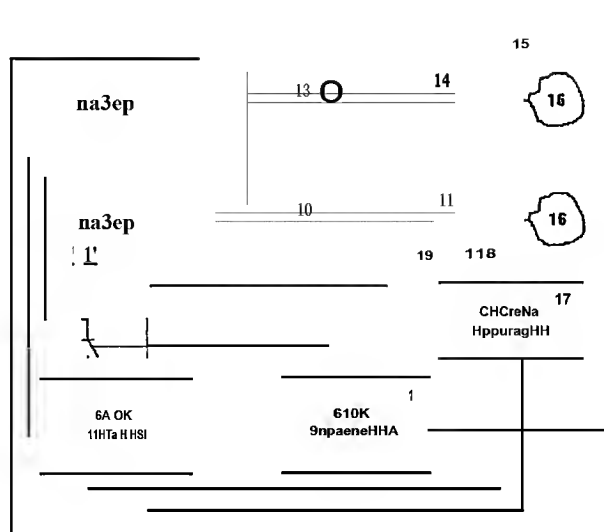
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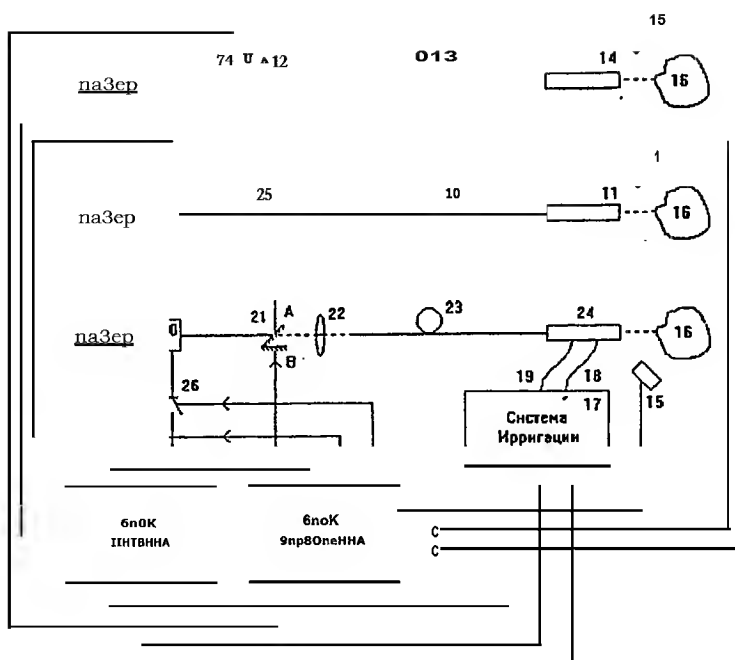
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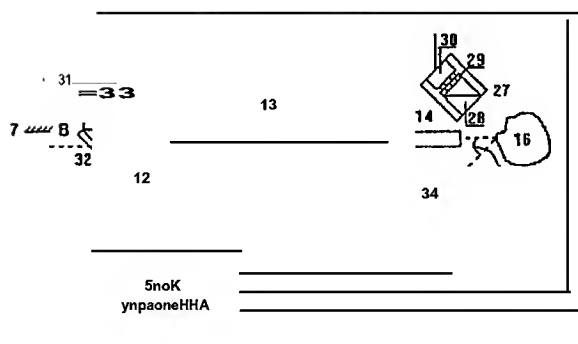
5. YCTpoilCTBO no nn.I H 2, o'Tnvlualonyeccl'reM, TTo npHeMBHKHHCPopMalijHH o COCTOSHHH 6HOnOrl<sup>1</sup>IeCKO<sup>d</sup> TKaHH BbInOHHell B BHJje aKyCTHyeCKOIO npHeMHHKa, yCTaHOBeHHOpO TaKHM O6pa3oM, yTO HanpaBneHHe ero MajCHManbHO\$I nyECTBHTeJbHOCTH cocTaBhleT c HanpanneHHeM onTHyeCKOk Oca Ha Bblxole HaKoneHHKa yron a, yroBJICTBOpHHHHVII yCnoBHIO li<sup>o</sup> d 88 6. YCTpoKCTBO HIO Hn.I H 2, o'mr<sup>#</sup>alollieccI TeM, wro sneKTpoHHbl<sup>#</sup> KnIOU BbinonHeH B BHJje HIOJllyOBOgHHKOBOpo HHHH 9neKTpoaKyyMnoro nepeKpouaTensl.

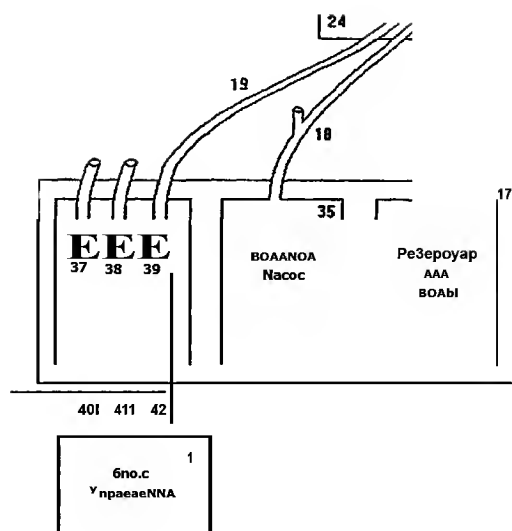
7. YCTpoCTBO no nn.I H 2, o'mnualonweccB TeM. tiro ono JononHTenbno cna6meno cHCpeMOH<sup>1</sup> opouemIH 3oHbi o6pa6o'rKH, coCrosllkeil H3 pe3epnyapa J~nsl BOJj;bl c Boj;siHbnM HacoCOM H BOJj;pynno<sup>9</sup> KoMnneccopa, C00TBCCTByIOHHHC BbIXOJ bI KOTOpbIX o6'beAHHeHbl B HaKOHenHHKaX H 3IB3\$HOCTH HppllralHOHHbIMH BbIXOJ{aMH yCTpOIACTBa, a BOJj;IYwbIH<sup>1</sup> KOMnpCCOOp B MCCTC coe nHeHHCI c BOJj;lyXOIpOBOAaMH CHa6KCH 3HeKTpOMarHHThbIMH KnanaHaMlll, nOj;KnIOneHHbIMH K BbIXOJjaM 6noKa ynpaBneHHCI.

Drawing(s) NepTexzx):









mt~r.4

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(Dmr.5